CHAPTER 1

INTRODUCTION

1.1 Background of the Study

2-ethylhexyl acrylate (2EHA) is a clear , volatile liquid that slightly soluble in water but fully soluble in alcohol, ethers and most organic solvent (Komoń et al., 2013). It has very good film formation property for which it is used in paints, adhesives, and coating applications (Haloi & Singha, 2011). In 2013, the acrylic esters had a total demand of 3,055KT globally. The Asia-Pacific region is that the largest market of acrylic esters products, accounting or more than 40% of the total world demand. The conventional production process for 2-ethylhexyl acrylate is catalytic dehydration of 2-ethyl hexanol and acrylic acid in a continuous process.

1.2 Motivation

2EHA was produced through the esterification of acrylic acid (AA) with 2EH in the presence of catalyst. The function of catalyst in the esterification process is to accelerate the chemical reaction by lowering the activation energy required for the reaction. In previous studies, homogeneous chemical catalysts, biocatalyst and enzymatic catalyst have been used in esterification reaction of AA.

Homogeneous catalysts are preferred in the conventional esterification reaction due to its higher catalytic activity (Nazriah & Hamdan , 2015). Homogeneous catalyst is used in the conventional method to accelerate the esterification reaction which takes days to achieve equilibrium (Ahmad et.al., 2014). Typical catalysts include sulfonic acid type catalysts such as benzene sulfonic acid, methane sulfonic acid, p-toluene sulfonic acid, or sulfuric acid, and phosphoric acid or phosphonic acid catalysts have been used for industrial esterification reaction. This reaction claimed to have several

drawback such as corrosion problem, difficult to be separated from the reaction mixture, time consuming and necessity to be neutralized after reaction (Ahmad et al., 2014; Akbay & Altiokka, 2011; Lilja et al., 2002; Liu et al., 2006) . A cheaper process is required to benefit the society as the demand of 2EHA is increasing.

1.3 Problem Statement

In previous studies, the esterification of AA with alcohol has been carried out using homogeneous catalyst such as sulfuric acid, hydrofluoric acid and para-toluenusulfuric acid (Altiokka & Ödeş, 2009). Homogeneous catalysts are preferred in the conventional esterification reaction due to its higher catalytic activity and cheaper price. However this method have several drawbacks such as difficult to separate from reaction medium and has corrosion problem (Akbay & Altiokka, 2011). Moreover, homogeneous catalyst can't be reused and the use of strong acid in homogeneous system give negative effect towards the reaction since it can cause corrosion, pollution of environment and catalyst recovery problem.

To overcome this, heterogeneous catalyst is recommended as the substitute to these homogeneous catalysts because it is insoluble, good in selectivity and inexpensive because it can be reused.

As for heterogeneous catalyst, the catalyst is usually in solid form and the reaction can take place either in liquid or gasses phase (Farnetti et al., 1999). Heterogeneous catalyst are insoluble, have good selectivity and specificity, can easily recovered and have good thermal stability (Farnetti et al., 1999). The esterification of acrylic acid with n-butanol with different type of heterogeneous catalyst such as Amberlyst-15, Amberlyst-131 and Dowex 50Wx-400 was studied (Sert et al., 2013).

In previous study, esterification of AA with 2EH was studied using batch reactor. In the case of mass production in the commercial process, a continuous reactor such as tubular reactor should be used.

To date, the study on the esterification of acrylic acid with 2-ethyl hexanol in tubular reactor with PK-208 (heterogeneous catalyst) as catalyst has not been reported in the literature. This reaction would contribute to the development of a feasible 2EHA

production with high yield. This method is expected to reduce the occurrence of side effect and increase the yield of the desired product. Moreover, this method could lead to the production of 2EHA with cheaper price.

1.4 Objectives

In the present work, esterification of acrylic acid (AA) and 2-ethyl hexanol (2EH) in tubular reactor to produce 2-ethylhexyl acrylate (2-EHA) is studied with the objectives of to investigate the effect of important operating parameter for the esterification of AA with 2EH catalyst by PK-208 in a tubular reactor.

1.5 Scopes of Study

The scopes of study for the present work included the investigation of effect of important operating parameters on the AA conversion and 2EHA yield. These parameters were reactant initial molar ratio of AA to 2EH (1:1, 1:3, and 1:5), temperature (75^0C to 95^0C) and catalyst loading (5 to 15g).